REMARKS

Claim 1, directed to a method for producing a xanthophyll from a photosynthetic microalga, has been amended to incorporate the limitations of claim 4, which has been canceled.

Claim 13 has been amended to delete the recitation of "xanthophyll-rich" as required in the final Office Action. In addition, claim 13 has been amended to define the claimed photosynthetic microalga cell as an encysted microalga cell obtained by the growth step of claim 1. Support for the amendment is found at the bottom of page 18 of the specification which describes the microalga cell shown in Fig. 2 as "encysted *Haematococcus* cells" which "contained zoospores tinged with red." (page 19, line 1.)

Applicant respectfully request that the amendments be entered since they address rejections and objections stated under 35 U.S.C. § 112 in the final Office Action, and also incorporate the limitations of claim 4 into claim 1 which would then be allowable according to the Examiner.

In summary, claims 1, 3, 5-11, and 13 are pending in the application and are under consideration. No additional claim fee is required as a result of the claim amendments.

Rejection under 35 U.S.C. § 112

Claim 13 was rejected under 35 U.S.C. § 112, second paragraph, because of the recitation of "xanthophyll-rich" in the description of the claimed microalga cell. Claim 13 has been amended in this response to delete the recitation of "xanthophyll-rich", and therefore is free of this ground of rejection.

Claims 1 and 3-11 were also rejected under 35 U.S.C. § 112, second paragraph, on the ground that the two steps recited in claim 1 (the growth step, and the encystment step) are redundant and confusing, in particular because they both refer to encystment. As requested in the Office Action, Applicant presents the following explanation, which shows that the two steps are distinct and clearly defined in claim 1:

1. The growth step uses encysted cells as a starting material. This starting material is inoculated into a nutrient medium and grown. As set forth on page 5, lines 13-17, of the specification, after these encysted cells have been grown in the nutrient medium, they release zoospores which contain xanthophyll, and the zoospores become vegetative cells which also multiply by cell division. As a result of these processes, a number of

vegetative cells is obtained which is larger than the original number of cells inoculated into the nutrient medium.

2. In the encystment step, the increased number of vegetative cells obtained in the growth step is then cultivated under a condition which leads to encystment of those vegetative cells, as set forth on page 5, lines 17-20.

In brief, encysted cells are inoculated into a nutrient medium and grown, as recited in the growth step of claim 1, and then the microalga obtained in that growth step is further cultivated under a condition which leads to encystment of that obtained microalga, as recited in the encystment step of claim 1.

Applicant submits that claim 1 describes the claimed process in sufficiently definite terms, and respectfully request that the rejection of claims 1 and 3-11 under 35 U.S.C. § 112, second paragraph, be reconsidered and withdrawn.

Rejection under 35 U.S.C. § 103(a)

Claims 1 and 3-11 were rejected under 35 U.S.C. § 103(a) as being obvious over Hata et al. The reference is cited for teaching a method for the production of astaxanthin by sequential heterotrophic-photoautotrophic cultivation of a green alga, using a growth step in a nutrient medium, and then an encystment step for encysting the microalga. Specifically, in the heterotrophic stage according to Hata et al, the goal of the cultivation is to obtain a "high cell concentration" (Abstract, line 2). For that reason, heterotrophic cultivation using acetate as a source of organic carbon nutrient is used. After the desired high cell concentration is reached, then according to Hata et al. the cultivation is switched to the autotrophic mode by providing illumination which causes the microalga to synthesize organic nutrients by photosynthesis. This autotrophic cultivation is for the purpose of production and accumulation of astaxanthin inside the microalga (Abstract, line 3.) The passage from Hata et al. which is cited in the Office Action states that "when the shift from heterotrophic to photoautotrophic condition was done when most of the cells had encysted, there was still a decrease in cell number but astaxanthin accumulation was very high." (Abstract, lines 12-14)

Hata et al. does not teach or suggest that encysted microalga be used as the starting material for cultivation, as recited in claim 1. The final Office Action states that it would have been obvious to use encysted microalga as the starting material because of the above quoted

teaching in the Abstract of Hata et al., namely that astaxanthin production was high when most of the cells produced in the heterotrophic cultivation had encysted.

The sequential heterotrophic-autotrophic cultivation taught by Hata et al. seeks to accomplish two goals which are equally important in the production of astaxanthin from microalga: (1) multiplication of the microalga; and (2) accumulation of astaxanthin in the microalga. Hata et al. achieves the first goal by heterotrophic cultivation, and achieves the second goal by autotrophic cultivation. Hata et al. further teaches a fine-tuning of the sequential cultivation, which fine-tuning consists of waiting until most of the cells in the first (heterotrophic) cultivation stage have encysted, before initiating the second (autotrophic) cultivation. The Office Action indicates that this fine-tuning taught by Hata et al. would provide motivation to a person of ordinary skill in the art to use encysted microalga as the starting material in the first cultivation stage. Applicant submits that a person of ordinary skill in this art would not consider that modification because it is known, as also stated in Hata et al. at page 396, last sentence of first paragraph in left column, that the rate of cell division of encysted cells is very low "so that once the cells have encysted, it becomes difficult to increase the cell number."

The above remarks are presented to show that the process recited in claim 1 prior to the present amendment is not obvious over Hata et al. However, in the interest of expediting prosecution of the application, Applicant has further amended claim 1 to incorporate therein the limitation originally recited in claim 4, to the effect that both the growth step and the encystment step recited in claim 1 are performed in a low nutrient medium. Hata et al. clearly does not teach using a low nutrient medium in both of the hererotrophic and autotrophic cultivation stages, and the Examiner had indicated that claim 1 as amended in that mannerwould be considered allowable.

Rejection under 35 U.S.C. § 102(b)

Claim 13 was rejected under 35 U.S.C. § 102(b) as being anticipated by Hata et al. The Office Action states that a photosynthetic microalga having a zoospore containing xanthophyll is considered merely a stage (encysted or non-encysted) in the microalgal growth cycle, and is no different than the zoospore taught by the reference. The Office Action further states that without

the explicit knowledge or exact content or extent of the richness of the xanthophyll content of the claimed microalga cell, the reference is considered to anticipate the claim.

To help define the claimed subject matter more clearly, claim 13 has been amended to recite that the claimed microalga cell is an encysted cell having a plurality of zoospores containing xanthophyll, and that it is produced by the growth step of claim 1. As described on page 5, lines 10-13, after encysted microalga cells have been grown in a culture medium, they release zoospores containing xanthophyll. Claim 13 is directed to this encysted microalga cell which has been cultivated in a nutrient medium in the growth step of claim 1, and still contains zoospores which have not been released. Such a microalga cell is shown in Fig. 2 of the application, which is described in the sentence bridging pages 18 and 19 as showing "encysted *Haematoccocusi* cells" which "contained zoospores tinged with red" (the red color showing the presence of astaxanthin.) The claimed microalgal cell is richer in astaxanthin than an encysted cell that has not been further cultivated in a nutrient medium as recited in claim 1. Hata et al. does not teach the cultivation of encysted microalga cells in a nutrient medium to the point where the encysted cells have zoospores which contain xanthophyll. Therefore, an encysted cell having zoospores which contain xanthophyll cannot be produced in Hata et al. Applicant respectfully request that the rejection of record be reconsidered and withdrawn.

Double patenting

Claims 1, 3-11 and 13 were provisionally rejected under the judicially created doctrine of double patenting over claims 5-14 of copending application number 11/**270**,116. (During the personal interview the Examiner provided the correct serial number for the copending application, which correct number is 11/**720**,116.) Since the copending application has not been examined yet, a terminal disclaimer will be filed in the copending application if such terminal disclaimer is found to be necessary during the prosecution of the copending application.

It is believed that the claims as amended in this response are patentable over the cited prior art. However, in the event the Examiner believes that there is any remaining issue and it may be resolved to place the application in condition for allowance, the Examiner is invited to contact Applicants' attorney at the telephone number listed below.

In the event this response is not considered to be filed timely, Applicant hereby petitions for an appropriate extension of the period for reply to the final Office Action. The fee for such petition may be charged to Deposit Account 502081.

Respectfully submitted,

McLELAND PATENT LAW OFFICE, P.L.L.C.

By: _____

Le-Nhung McLeland
Attorney for Applicants
Reg. No. 31,541

11320 Random Hills Road
Suite 250
Fairfax, VA 22030
Tel: (703) 323-4446; Fax: (703) 323-8188